University of Guelph

(18)

DEPARTMENT OF HORTICULTURAL SCIENCE

15th PLANT DEVELOPMENT WORKSHOP

SATURDAY, MAY 4, 1985

PHYSICAL SCIENCES, ROOM 113

PRELIMINARY SCHEDULE:

08:30 - 09:15	Registration, coffee
09:15 - 09:45	Comments on Plant Biotechnology, and Molecular Biology and Genetics at Guelph
09:45 - 12:00	Contributed papers
12:00 - 14:00	Buffet lunch, poster presentations, tours
14:00 - 16:30	Contributed papers and discussion
16:30 - 17:00	Reception

PRESENTATIONS:

Please submit title(s), abstract(s), and author(s') name(s) and address(es) on the enclosed sheet by April 10, 1985. We will attempt to return a programme to you before the meeting.

Please return the form at the bottom in the enclosed envelope so food services can be arranged.

ALL COMMUNICATIONS TO:

Jane M. Petitte
Department of Horticultural Science
University of Guelph
Guelph, Ontario
N1G 2W1

Phone: (519) 824-4120 ext. 2728 or 3036

My group ( ) will attend; ( ) may attend
If you need accommodations please contact us as soon as possible.
Abstract(s) and Title(s) enclosed ( ); to be sent later ( ).

Name:_____ No. in group _____

15th PLANT DEVELOPMENT WORKSHOP

Submit title, abstract, and author(s') name(s) and address(es) to:

Jane M. Petitte, Dept. of Horticultural Sci., Univ. of Guelph,
Guelph, Ontario N1G 2W1

Type of presentation: ____ a poster; ____ oral presentation.

(15)

UNIVERSITY OF GUELPH

DEPARTMENT OF HORTICULTURAL SCIENCE

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Fragaria virginiana

Hitchcock, S.T. 1980. Harper & Row, New York.

15th PLANT DEVELOPMENT WORKSHOP MAY 4, 1985 UNIVERSITY OF GUELPH

Final Program

8:30 - 9:15 Registration, coffee, poster set-up
Foyer, Physical Sciences Building

9:15 - 9:20 Announcements. Room 113. Physical Sciences - D.P. Ormrod

9:20 - 9:25 Welcome. W.E. Tossell, Dean of Research

9:25 - 9:35 Comments on Center for Plant Biotechnology
- K. Kasha, Director

9:35 - 9:45 Comments on Department of Molecular Biology and Genetics - R. Nazer, Chairman

9:45 - 10:45 **Session 1.** Development/Physiology Papers
- Chaired by Lorna Woodrow

10:45 - 12:00 **Session 2.** Anatomy Papers
- Chaired by Jane Young

12:00 - 13:00 Buffet Lunch Room 240B Horticultural Science
(Approx. cost $4.00)

13:00 - 14:15 Optional tours. Poster session, Physical Sciences foyer

13:00 - 13:30 Conducted tour of new Molecular Biology and Genetics area, Biology Building

13:40 - 14:10 Conducted tour of Plant Biotechnology Research area, Crop Science Building

13:00 - 14:15 Self-conducted tour of Horticultural Greenhouses

14:15 - 15:30 **Session 3.** Mycorrhiza/Pathology Papers
- Chaired by Bev Marie

15:30 - 16:30 **Session 4.** Techniques/Tissue Culture/Growth Regulation Papers
- Chaired by Jane Petitte

16:30 - 17:00 Reception, Enology Genetics Laboratory, Biology Building.
Arranged by Ron Subden

Note: Please let Jane Petitte at (519) 824-4120 (Ext. 2728) know of any additional participants beyond your initial response as we must have accurate numbers for the buffet lunch and reception

All Plant Biology graduate students, staff and faculty are welcome

ABSTRACTS OF PAPERS

SESSION 1 DEVELOPMENT/PHYSIOLOGY - Chaired by Lorna Woodrow

9:45-10:00 EARLY STAGES IN THE DEVELOPMENT OF THE PROMPT BUDS AND WINTER BUDS OF VITIS RIPARIA MICHX. -- Jean M. Gerrath & U. Posluszny. Department of Botany, University of Guelph, N1G 2W1.

It has long been known that grapes produce two types of buds in each leaf axil. The "prompt bud" elongates about 5 cm. in early summer. It rarely produces fruit, and usually abscisses in late summer. The "winter bud" forms beside it and remains dormant until the following spring, when it elongates to produce that year's fruit crop. Scanning electron microscopy and epi-illumination light microscopy studies of the early stages of development of these two bud types show that the winter bud is in fact the axillary bud of the basal scale leaf of the prompt bud. Thus grapes do not produce supernumerary axillary buds. Instead, axillary bud initiation follows the typical pattern, but further bud development obscures the initial relationship.

10:00-10:15 DEVELOPMENTAL CHANGES IN EPICARP HAIRS OF WHEAT
A.G. Sangster, M.J. Hodson and D. Wynn Parry. Glendon College, York University, Toronto, and School of Plant Biology, University College of North Wales, U.K.

Previously, silicon had been detected in mature epicarp hairs, but its precise location and the timing of silicification with wall thickening during development were not known. Therefore, to determine ultrastructural features, harvests of the ovary and caryopsis of wheat (Triticum aestivum L. cv. Highbury) extending from emergence to maturity were obtained. Transections of epicarp hairs and associated tissues were investigated by transmission electron microscopy, and analyses were performed using an EDAX energy dispersive X-ray analyzer. Wheat ovaries showed a range of developmental stages depending upon their position on the inflorescence axis. Epicarp hairs first develop as papillae on the ovary wall before emergence of the panicle. Elongation is remarkably rapid reaching mature lengths up to 800 µm by one week after emergence when other ovary tissues are still immature. Silicon deposition is coordinated both with elongation and with wall thickening, being initiated in the tips of the hairs prior to emergence, and subsequently along the whole of the length as a thin layer at the outer wall edge, within a week of inflorescence emergence.

10:15-10:30 SUBERIN DEPOSITION AS A NONSPECIFIC RESPONSE TO INJURY IN TREES A.R. Biggs, Agriculture Canada, Research, Vineland Station, Ontario, Canada, LOR 2E0.

Suberin linings (ca. 0.5um) were detected in impervious boundary zone tissues formed prior to wound periderm initiation in 15 woody angiosperms. Suberization was associated with individual cells or cell layers formed as a response to mechanical wounding, fungal inoculation, or during rhytidome formation, Fluid diffusion was inhibited by this tissue prior to regeneration of suberized wound periderm. Detection of boundary zone suberin was facilitated by the use of enhancing and quenching effects of conventional histochemical tests for suberin and lignin in conjunction with ultraviolet and blue-violet fluroescence microscopy. Phloroglucinol + HCl or toluidine blue O applied to boundary zone tissues resulted in quenched bright blue autofluorescence of lignified cells and facilitated detection of the deep violet autofluorescence of suberin linings. Application of Sudan black B specifically quenched the autofluorescence of suberin in the boundary zone and phellem.

10:30-10:45 PERMEABILITY OF THE MESTOME SHEATH IN GRASSES OF DIFFERENT PHOTOSYNTHETIC TYPES. P. Ann Eastman and Carol A. Peterson, Dept. Biology, University of Waterloo, and Nancy G. Dengler, Dept. Botany, University of Toronto.

The mestome sheath surrounding the major vascular bundles in grass leaves has striking anatomical similarities with the State III endodermis encircling the vasculature in roots. These anatomical parallels have encouraged the concept of possible functional parallels. Until recently, most work on the mestome sheath has indicated that it does have an impact on the apoplastic movement of water in a manner analogous to the apoplastic barrier provided by the Casparian bands of the endodermis. To investigate this perception, grass leaves representing different photosynthetic and thus, different anatomical types, were examined for the presence of suberin, lignin and phenolics in the mestome sheath cell walls using conventional and fluorescence histochemical techniques, acid digestion and the movement of an apoplastic fluorescent dye, PTS. Although gross histochemical tests gave similar responses for the mestome sheath and the endodermis, acid digestion revealed the lack of a Casparian band or similar structure in the mestome sheath of all species observed. PTS clearly diffused outward,in almost all species, from the vasculature to the mesophyll within minutes of application. We conclude the mestome sheath of all grass leaves tested is permeable to the apoplastic movement of water and thus, is not functioning as an endodermis.

SESSION 2 ANATOMY - Chaired by Jane Young

10:45-11:00 AN IMPROVED FIXATION PROTOCOL FOR ULTRASTRUCTURAL STUDIES OF ECTOMYCORRHIZAE. *H.B. Massicotte, C.A. Ackerley* and *R.L. Peterson*, Department of Botany, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

Ectomycorrhizae between Alnus crispa and Alpova diplophloeus were synthesized in plastic growth pouches. Several fixation protocols were used to study the ultrastructure of both symbionts. The best fixation included the primary fixative, 2.5% glutaraldehyde in HEPES buffer (0.1OM, pH 6.8) for 3 hr at room temperature, followed by 2% aqueous O_8O_4 for 2 hr at 4°C. Material was embedded in various resins. Tissue fixed by the procedure outlined showed good cytoplasmic preservation of both fungus and plant cells. Nuclei are well preserved in both symbionts and there is no distortion of endoplasmic reticulum and mitochondria. The most obvious improvement in fixation is with the fungus, since rough endoplasmic reticulum, mitochondria and nuclei are particularly well-preserved. Microtubules are also evident in the host. This fixation technique also preserves the cytoplasm of cells in the centre of ectomycorrhizal roots, and preliminary results indicate that it gives excellent results with other plant tissues. In contrast to these results, other fixation techniques gave an overall granular effect to the cytoplasm of both symbionts and the organelle membranes lacked clear definition.

11:00-11:15 Changes in microtubule and wall microfibril arrays during in vitro cotton fiber development: a study using immunofluorescence. Robert Seagull, Department of Biology, Carleton University, Ottawa.

Cotton fibers provide an excellent system to study how cortical microtubule (mt) arrays are established and the relationship between mt organization and cell wall microfibril (mf) deposition. Mt organization is monitored using an indirect immunofluorescence technique. Wall deposition is monitored using calcofluor staining and polarization optics. Throughout development, cotton fibers maintain a highly organized array of cortical mts. For the first 15-18 days after anthesis, mts are oriented transverse to the long axis of the cell. Cell walls exhibit increasing amounts of birefringence during this time, with mfs oriented parallel to the mt arrays. Older fibers contain mts oriented in a spiral array. This switch from transverse to spiral appears to occur along the entire fiber very rapidly since the two mt patterns are not found simultaneously within the same cell. This observed change in mt organization is followed by the deposition of mfs with the new orientation. Older fibers also exhibit abrupt reversals in mt orientation. These "reversals" occur in two distinct patterns and result in abrupt shifts in wall mf orientation. The observed changes in mt orientation during cotton fiber development may be the result of shifting preformed mt arrays, via some as yet undescribed mechanism.

11:15-11:30 The Organization of Microtubule Arrays Before Differentiation Determines Secondary Wall Patterns During Xylogenesis in Tissue Culture. Marcia M. Falconer and Robert W. Seagull, Carleton University, Ottawa, Ontario.

Groups of microtubules (mts) preceed and predict the dèposition of secondary wall during xylogenesis in tissue culture. The organization of these cortical mts prior to differentiation determines (or reflects) the cell shape. Elongated cells have mt arrays organized transverse to the long axis of the cell while isodiametric cells have basically random mt arrays. When these cells differentiate into tracheary elements (TEs), secondary wall patterns form two distinct types: bands and webs. Band patterns are seen in elongated TEs while web patterns are found in isodiametric TEs. Individual cells with areas of both cylindrical and hemispherical shape can often be seen. Differentiation of these cells into TEs results in band patterns forming in the cylindrical areas while web patterns are seen in the areas that are hemispherical in shape. From this evidence it is possible to formulate an hypothesis: The organization of cortical mt arrays before differentiation determines the secondary wall patterns in tracheary elements. Lateral aggregation of microtubules in these arrays may be the mechanism behind this event.

11:30-11:45 Changes in the nuclear size in the Abies balsamea vascular cambium during dormancy.
Seasonal variations in nuclear size of fusiform initials were observed on Abies cambial squash preparations after Feulgen staining. The nuclei were about 2 times longer during winter dormancy than during the proliferative period. The width was less variable. The nuclear volume,calculated as an ellipsoid from the dimensions measured was much smaller in the spring and summer than in the winter.The volume maxima were observed: first in mid-October - during rest-quiescent continuum,second in December - right after the cambium became fully quiescent, and third at 2 weeks before the first mitoses were recorded. It is not known whether these changes reflect i)the hydration of the nuclei, ii)the variation in the dry mass (for example in the level of proteins,DNA,RNA), or iii)the arrangement of nuclear components (for example the degree in chromatin condensation).Nor it is known if these changes occur in all overwintering cells or whether they are restricted to the meristematic cells. The observed temporal correlations with the state of cambial dormancy may support the letter possibility. Ewa Mellerowicz - Dept.Biology/Univ.New Brunswick 45111 Fredericton/ N.B. E3B 6E1

11:45-12:00 BUNDLE SHEATH AND MESOPHYLL DIFFERENTIATION IN THE LEAVES OF THE C_4 GRASSES PANICUM EFFUSUM AND P. BULBOSUM. R.E. Dengler* and N.G. Dengler, Scarborough Campus and Department of Botany, University of Toronto.

The two Panicum species examined differ in photosynthetic type and in developmental origin of their bundle sheaths. In P. effusum (NAD-malic enzyme type) both mesophyll cells and bundle sheath cells are derived from ground meristem, while in P. bulbosum (NADP-malic enzyme type), in contrast to the mesophyll, bundle sheath cells are derived from procambium. To test the hypothesis that the developmental divergence of bundle sheath and mesophyll cells would occur earlier in P. bulbosum, observations of cell size, vacuole size, organelle size and number, wall thickness and contact with intercellular space were made, based on direct and digitizer measurement of transmission electron micrographs of leaf cross sections of successive developmental stages. Growth in intercellular space is the only parameter in which significant differences between bundle sheath and mesophyll cells occur earlier in P. bulbosum than P. effusum. Other features such as cell cross-sectional area appear to diverge earlier in P. effusum. Therefore, we did not find clear evidence that the early separation of cell lineages strongly influences the timing of later differentiation of bundle sheath and mesophyll cells.

SESSION 3 MYCORRHIZA/PATHOLOGY - Bev Marie

14:15-14:30 VESICULAR-ARBUSCULAR MYCORRHIZAL ASSOCIATIONS OF VASCULAR PLANTS ON HERON ISLAND, A GREAT BARRIER REEF CORAL CAY. *R.L. Peterson*, A.E. Ashford* and *W.G. Allaway*, Department of Botany, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

Roots of 42 species of angiosperms collected from all vegetation zones on Heron Island were cleared, stained with chlorazol black E, and assessed for vesicular-arbuscular mycorrhizae (VAM). Intensity of colonization was determined using the gridline intersect method while stages in internal development of the mycorrhizal association were determined by mounting cleared root pieces on microscope slides and examining them with Nomarski differential interference contrast microscopy. Fifty-seven percent of the species had VAM and of these the intensity of colonization varied from 3-100% The majority (77%) of species occurring in the strand vegetation zone were colonized by VAM fungi and these tended to have the most intense colonization About half the species located in the shrub zone, the Pisonia forest and disturbed sites had VAM. All but 3 species with VAM had both arbuscules and vesicles; Casuarina equisetifolia var. incana, Sisymbrium orientale and Tribulus cistoides lacked arbuscules. Two species of Brassicaceae, a family which is usually non-mycorrhizal, had VAM associations. This survey, the first of its kind on a Great Barrier Reef coral cay, adds to the limited information available on the occurrence of VAM in natural ecosystems.

14:30-14:45 THE EFFECT OF CADMIUM ON THE GROWTH OF THE MYCORRHIZAL FUNGUS Paxillus involutus. A. Darlington and W.E. Rauser. Dept. of Botany, Univ. of Guelph.

The response of Paxillus involutus to cadmium was studied in pure culture. Growth as measured by the rate of increase in mass and total length was less sensitive to the presence of cadmium than were the other growth parameters such as degree of branching, cell size and the radial expansion of the mycelium on agar.

14:45-15:00 MYCORRHIZA SYNTHESIS BETWEEN STRAINS OF PISOLITHUS TINCTORIUS AND EUCALYPTUS PILULARIS *D.J. Grenville, R.L. Peterson* and *A.E. Ashford,* Department of Botany, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

Five strains of Pisolithus tinctorius were effective in forming mycorrhizae with Eucalyptus pilularis when grown in non-sterile growth pouches. The main difference among the strains was the rate of colonization. External morphology and internal anatomy of the mycorrhizae were similar to soil-grown Eucalyptus mycorrhizae. Fungal hyphae of the inner mantle and Hartig net stored phosphorous as polyphosphate bodies, determined by their metachromasy with toluidine blue and X-ray microanalysis. These polyphosphate bodies normally have calcium as the major cation associated with phosphorous.

15:00-15:15 TURNIP MOSAIC VIRUS DISEASE IN RUTABAGA. Vernon Shattuck, Dept. of Hort. Science, Univ. of Guelph, Guelph, Ontario N1G 2W1

Turnip Mosaic Virus (TuMV) is a disease infecting cruciferous plants. This virus in recent years has caused important losses to both growers and distributors of rutabagas in Ontario. Once established in an area it is difficult to control the movement of TuMV into adjacent fields since the control of virus transmitting agents is not easily accomplished. TuMV infected rutabaga plants may fail to develop roots of marketable size or produce roots with increased susceptibility to breakdown in storage. Current control recommendations for this disease are commonly oriented towards eliminating virus contaminating sources in the field. Despite sanitary precautions serious outbreaks of TuMV in Ontario have arisen and have proven costly.

In an effort to establish control for this disease the Horticultural Department at Guelph is currently investigating the feasibility of incorporating TuMV resistance into rutabagas. This presentation will focus on the efforts made to date on this project.

15:15-15:30 CYTOLOGICAL RESPONSES OF THE NONHOST SPECIES, PHASEOLUS VULGARIS, TO PLANT PATHOGENIC FUNGI. Myriam R. Fernandez* and Michele C. Heath, Botany Department, University of Toronto, Toronto, Ontario, Canada. M5S 1A1

Responses of the nonhost French bean plant (Phaseolus vulgaris) to five plant pathogenic fungi, varying in their mode of nutrition, were examined by cytological and histochemical techniques. All fungi penetrated bean leaves and elicited cellular modifications of the plant. The least biotrophic fungi seemed to elicit a higher frequency of accumulation of phenolic compounds, autofluorescence of cell contents and browning of cells, than the least biotrophic ones. The latter, in turn, elicited a greater accumulation of aniline blue-fluorescent material and thicker wall deposits than the former fungi. Decolorization and clearing of the tissue for light microscopy induced changes in the frequencies of autofluorescence of cell contents and walls when compared with those observed in fresh tissue. Toluidine blue staining also revealed that materials other than phenolics were detected by autofluorescence of cleared tissue in these interactions.

SESSION 4 TECHNIQUES/TISSUE CULTURE/GROWTH - Jane Petitte

15:30-15:45 Charring, Ashing and Measurement of Calcium by Atomic Absorption Spectroscopy. I. Ockenden and J.N.A. Lott, McMaster University, Hamilton, Ontario, L8S 4K1

There is a considerable variation in fruit and seed size within the genus Cucurbita. In studying the mineral composition of the embryos of such seeds, it becomes desirable at times to measure minerals within individual seeds. These seeds may be as small as 0.02 g or as large as 0.4 g. In measuring calcium by atomic absorption spectroscopy it was found that embryo samples of small size gave consistently higher calcium levels than larger samples of the same specimens. This problem was traced to the charring and ashing steps, but was not related to improved level of ashing. Calcium was found to be less readily extractable from the more highly oxidized light grey ash produced at 650°C than from the black ash derived from 500°C ashing. This lower availability of calcium for measurement is not affected by the oil content of the embryos, but appears to be related to the balance of potassium, phosphorus and calcium within the tissues being ashed.

15:45-16:00 EFFECTS OF MEDIA COMPOSITION, EXPLANT ORIENTATION AND PHENOLICS ON CYTOKININ-INDUCED CAULOGENESIS FROM PINUS STROBUS EMBRYONIC EXPLANTS. B. Flinn and D. T. Webb, Dept. of Biology, Queen's University, Kingston, Ontario K7L 3N6.

The ability of SH and MS media to support caulogenesis was compared, using P. strobus embryos and 1 mg/L BA. For caulogenesis, SH medium was better than MS. MS medium supported some caulogenesis, but yielded more callogenesis. Macronutrients were found to be the major regulatory components of the media, but MS organics enhanced caulogenesis. A 1 week vertical BA exposure, with cotyledon immersion in the medium, followed by horizontal culture on BA (4 weeks total BA exposure) enhanced caulogenesis compared to horizontal controls. Optimal caulogenesis by excised cotyledons was achieved after 1 week vertical BA exposure or 2 weeks horizontal exposure. Phenolic compounds, known to affect tobacco caulogenesis via their effects on IAA oxidase activity, had no significant effect on BA-induced caulogenesis by excised cotyledons.

16:00-16:15 EFFECTS OF LIGHT INTENSITY AND NAA CONCENTRATION ON IN VITRO EMBRYOGENESIS AND RHIZOGENESIS FROM EGGPLANT (SOLANUM MELONGENA L.) COTYLEDONS. P.R. Fobert and D.T. Webb, Dept. of Biology, Queen's University, Kingston, Ontario K7L 3N6.

Excised cotyledons of eggplant (cv. Imperial Black Beauty) cultured on modified MS medium readily form roots and embryos in the presence of NAA. Low NAA concentrations (0.1 mg/L) favour rhizogenesis while high concentrations (5-10 mg/L) favour embryogenesis. Roots and embryos develop in intermediate numbers at concentrations of 0.5-1.0 mg/L. Explants cultured in the dark or at low light intensity (35 $\mu E/m^2$ s) form both roots and embryos. Increasing light intensity (up to 195 $\mu E/m^2$ s) results in increased embryo formation and reduced root formation. Embryos formed at high light intensities are more developmentally advanced than those formed at low light intensities or in the dark. Light is not an absolute requirement for embryogenesis from eggplant cotyledons, but enhances the growth and differentiation of embryos. Current research is focussed on elucidating the role of polyamines in embryogenesis. These compounds have recently been implicated in a number of plant growth and developmental processes including somatic embryogenesis from carrot suspension cultures.

16:15-16:30 TRIADIMFEON - A FUNGICIDE AND PLANT GROWTH REGULATOR. R.A. Fletcher, G. Hofstra, N.K. Asare-Boamah and V. Arnold, Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1.

Triadimefon, a sterol-inhibiting fungicide, inhibits biosynthesis of ergosterol in fungi and gibberellins in plants. As a consequence, it modifies plant growth and development. The treated plants are shorter, more compact with thicker and darker green leaves than the controls. Triadimefon increases stomatal resistance, reduces transpiration and increases yield under water stress conditions. It stimulates chlorophyll synthesis and root growth. In addition to its established fungicidal properties triadimefon also protects plants from injury due to drought, chilling and ozone. It is suggested that the growth regulating properties of triadimefon are mediated by interfering with the isoprenoid pathway and thus shifting the balance of important plant growth hormones including cytokinins, abscisic acid and gibberellic acid.

ABSTRACTS OF POSTERS

MYCELIUM DERIVED FROM SCLEROTIA AS A SOURCE OF INOCULUM FOR ECTOMYCORRHIZAE. *D.J. Grenville, Y. Piche* and *R.L. Peterson,* Department of Botany, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

Sclerotia of Pisolithus tinctorius and Paxillus involutus were produced in the extramatrical mycelium of ectomycorrhizae established between these fungi and Pinus strobus or Pinus resinosa in plastic growth pouches. Sclerotia were collected, stored dry for up to 30 days, surface sterilized and germinated on Melin-Norkrans agar medium. After two weeks, mycelium plugs were placed adjacent to Pinus strobus and Pinus resinosa roots in growth pouches. The sclerotium-derived mycelium was successful in forming mantles on short roots of both pine species. Sections of these roots showed that a well-developed Hartig net was formed.

SCLEROTIUM DEVELOPMENT IN TWO ECTOMYCORRHIZAL FUNGI. *D.J. Grenville, Y. Piche* and *R.L. Peterson,* Department of Botany, University of Guelph, Guelph, Ontario, Canada. N1G 2W1.

Plugs of mycelium of the ectomycorrhizal fungi Pisolithus tinctorius and Paxillus involutus induced mycorrhizae on short roots of Pinus strobus and Pinus resinosa in plastic growth pouches. Sclerotia which formed in the extramatrical mycelium of these mycorrhizae were collected at various stages to study their ontogeny, structure and histochemistry. Sclerotia of P. tinctorius are initiated by small hyphal branches which grow at right angles to a hyphal strand. Frequent branching results in a lenticular swelling on the strand. Mature sclerotia had a thick-walled black outer rind, a thick-walled outer cortex, an inner cortex, and a filamentous medulla. Glycogen, protein and lipid were stored in cells of the sclerotium. Sclerotia of P. involutus were initiated by hyphal tips which branched and proliferated. Mature sclerotia consisted of a one-two celled pigmented rind, a narrow cortex, and a large medulla. Glycogen, protein, and lipids were present in mature sclerotia.

POLYNOMIAL EQUATIONS FOR THE REPAIR AND/OR COMPENSATION OF GROWTH EFFECTS OF O_3 AND SO_2 ON Brassica napus var. napitata. B.A. Marie and D.P. Ormrod, Dept. of Horticultural Sci., Univ. of Guelph, Guelph, Ont.

A central composite design and analysis of covariance were used to investigate the repair and/or compensation of various growth parameters of rutabaga plants during a four day period following an exposure to SO_2 and O_3 mixtures. Polynomial equations and contour plots depicted the change in pollutant effects on growth variables at each 24h interval after exposure.

The three growth variables differed slightly in their repair/compensation patterns. Shoot fresh weight was reduced by SO_2 for the first two days and by O_3 for all four days. Shoot dry weight was stimulated by SO_2 on the first day, reduced on the second day and unaffected for the last two days. Leaf area was reduced by SO_2 for the first three days, and by O_3 for all four. Intercepts increased with time, indicating that growth was occurring after the exposure, and decreasing R^2 values indicated increasing variability with time.

GROWTH AND YIELD OF TOMATO PLANTS EXPOSED TO OZONE IN FIELD CHAMBERS AT TWO DEVELOPMENTAL STAGES. A.Z. Tenga and D.P. Ormrod, Dept. of Horticultural Sci., Univ. of Guelph, Guelph, Ont.

Tomato plants in pots were exposed in open-top chambers to 7-hr day^{-1} episodes at 4 levels of ozone (O_3) for 4 consecutive days at either a vegetative or flowering stage. Plants were harvested one day later or at the fruiting stage. Plants exposed at a vegetative stage were more sensitive to O_3 than those exposed at flowering. The carry-over effects at time of fruiting were greater with exposure at the vegetative stage. The response of individual growth and developmental variables varied according to treatment stage and harvest time.